

WO 01/21279

PCT/US00/26112

What is claimed is:

1. A filter element comprising a pleated composite including a filter layer having first and
5 second sides, and a first functional drainage layer disposed proximate the first side of the filter
layer, the first functional drainage layer comprising a functional material and having a lower
edgewise flow resistance than the filter layer.
2. A filter element as claimed in claim 1 wherein the composite has a plurality of pleats,
10 each having first and second legs, the first leg contacting the second leg of the same pleat and the
second leg of an adjacent pleat over a substantial portion of the height of the first leg.
3. A filter element as claimed in any preceding claim wherein the first functional drainage
layer has an edgewise flow resistance at most approximately 50% that of the filter layer.
15
4. A filter element as claimed in claim 2 wherein the first leg contacts the second leg of
the same pleat and the second leg of an adjoining pleat over a substantially continuous region
extending for a substantial portion of the height of the first leg and over at least fifty percent of an
axial length of the filter element.
20
5. A filter element as claimed in claim 1 wherein the pleated composite includes a second
functional drainage layer disposed on the second side of the filter layer and comprising a
functional material and having a lower edgewise flow resistance than the filter layer.
- 25 6. A filter element as claimed in claim 1 wherein the first functional drainage layer
comprises a porous fibrous sheet containing the functional material.
7. A filter element as claimed in claim 1 wherein the first functional drainage layer
contacts the filter layer.
30
8. A filter element as claimed in claim 1 wherein the filter element is cylindrical.

WO 01/21279

PCT/US00/26112

9. A filter element as claimed in claim 2 wherein the plurality of the pleats each have a radially outer end displaced in a circumferential direction of the filter element with respect to a radially inner end of the pleat.
- 5 10. A filter element as claimed in claim 2 wherein the pleats are substantially parallel to each other.
11. A filter element comprising a composite of a filter layer and a fibrous sheet comprising a functional material and having a lower edgewise flow resistance than the filter layer,
- 10 the composite being spirally wrapped around a hollow center of the filter element.
12. A filter element comprising:
a composite of first and second drainage layers and a filter layer disposed between the drainage layers, at least one of the drainage layers comprising a functional material, each
- 15 drainage layer having a lower edgewise flow resistance than the filter layer, the composite being spirally wrapped around an axis.
13. A filter element as claimed in claim 12 wherein both drainage layers comprise a functional material.
- 20 14. A filter element as claimed in any one of claims 12-13 wherein a drainage layer comprises a fibrous sheet in which particles of the functional material are integrated.
15. A filter element comprising:
a support plate;
- 25 a filter layer disposed on the support plate; and
a drainage layer having a lower edgewise flow resistance than the filter layer disposed between the filter layer and the support plate and comprising a functional material.
- 30 16. A filter element as claimed in claim 15 wherein the support plate has an opening through which fluid can flow between opposite surfaces of the plate.

WO 01/21279

PCT/US00/26112

17. A filter element as claimed in claim 15 or 16 wherein the support plate is annular and an opening is at a radial center of the support plate.

5 18. A filter element comprising a plurality of filter layers, a plurality of first drainage layers, and a plurality of second drainage layers, each of the filter layers being sandwiched between one of the first drainage layers and one of the second drainage layers, each of the drainage layers having a lower edgewise flow resistance than the filter layers, a plurality of the drainage layers comprising a functional material.

10

19. A filter element as claimed in claim 18 wherein the first drainage layers are sealed off on an upstream side of the filter element and the second drainage layers are sealed off on a downstream side of the filter element.

15 20. A filter element as claimed in claim 18 or 19 wherein each of the drainage layers comprises a functional material.

21. A filter element as claimed in claim 18 wherein each of the filter layers and each of the drainage layers is substantially flat.

20

22. A method of treating a fluid comprising:
passing a fluid through a filter layer and edgewise through a functional drainage layer on a first side of the filter layer of a pleated filter composite to filter the fluid in the filter layer and treat the fluid with a functional material in the functional drainage layer.

25

23. A method as claimed in claim 22 including passing fluid through a second drainage layer disposed on a second side of the filter layer.

24. A method as claimed in claim 22 or 23 including passing the fluid in an axial direction
30 of the pleated filter composite between opposite lengthwise ends thereof.

WO 01/21279

PCT/US00/26112

25. A method as claimed in claim 22 or 23 including passing the fluid primarily in an axial direction of the pleated filter composite through the first functional drainage layer.

26. A method as claimed in claim 22 or 23 including passing the fluid through the first functional drainage layer primarily along a height direction of the pleats.

27. A method as claimed in any of claims 22-23 wherein the pleated filter composite comprises a cylindrical configuration.

28. A method as claimed in any of claims 22-23 wherein the pleats are parallel to each other.

29. A method of treating a fluid comprising:

passing a fluid in an edgewise direction within a first drainage layer disposed on a first side of a filter layer, then passing the fluid through the filter layer to filter the fluid, and passing the fluid in an edgewise direction within a second drainage layer on a second side of the filter layer, at least one of the drainage layers containing a functional material which treats the fluid passing through it, each drainage layer having a lower edgewise flow resistance than the filter layer.

30. A method of treating a fluid comprising:

passing a fluid through a filter layer disposed on a support member to filter the fluid and through a functional drainage layer disposed between the filter layer and the support member and containing a functional material to treat the fluid with the functional material.

31. A method as claimed in claim 30 including passing the fluid through the filter layer before passing the fluid through the functional drainage layer.

32. A method as claimed in claim 30 wherein the support member comprises an annular plate having an opening at a center thereof, the method including passing the fluid through the drainage layer in a radial direction of the plate.